CLAIMS

1. A data transmission system including a plurality of data transmission devices connected via a transmission line so as to form a ring structure, for performing unidirectional electrical communication after each of the data transmission devices establishes clock synchronization, wherein,

each of the data transmission devices includes:

a processing section for processing data received and to be transmitted based on a predetermined communications protocol;

a transmission/reception section for outputting data received from a previous data transmission device to the processing section and transmitting a processing result from the processing section to a subsequent data transmission device;

a control section for setting the device as a master, which sends a signal synchronizing with a held reference clock to the subsequent data transmission device, or as a slave, which establishes clock synchronization using a signal received from the previous data transmission device and sends a signal to the subsequent data transmission device;

lock signal sending means for sending a lock signal in an initial operation;

clock synchronization means for receiving the lock signal sent by the previous data transmission device and establishing the clock synchronization;

start signal sending means for sending a start signal that indicates a data communication start timing;

start signal commencement timing generation means for, when the device is set as the master, outputting to the start signal sending means a start signal sending commencement signal indicating a timing at which to send the start signal, after a predetermined time period elapses after the lock signal sending means sends the lock signal; and

a signal detection section for detecting whether a signal has been received from the previous data transmission device,

the lock signal sending means

when the device is set as the master, sends to the subsequent data transmission device the lock signal synchronizing with the held reference clock, and

when the device is set as the slave, receives the lock signal sent by the previous data transmission device and establishes clock synchronization, and, after establishing the clock synchronization, sends the lock signal further to the subsequent data transmission device, and

the start signal sending means

when the device is set as the master, receives the start signal sending commencement signal from the start signal commencement timing generation means and thereafter sends the start signal to the subsequent data transmission device, and

when the device is set as the slave, sends the start signal to the subsequent data transmission device in response to reception of the start signal sent from the previous data transmission device,

whereby each of the data transmission devices performs initialization.

2. The data transmission system according to claim 1, wherein

the control section sets the device as a master or a slave based on a presence or absence of a signal detection in the signal detection section,

whereby, when there is a portion where the electrical communication is impossible, a data transmission device located most upstream in the electrical communication from the portion is set as the master.

3. The data transmission system according to claim 2, wherein,

the control section

when the device is set as the master in the initial operation, causes the lock signal sending means to send the lock signal and, after recognizing that the signal detection section has not detected a signal from the previous data transmission device within a predetermined time period, sets the device as a slave

if the signal detection section of the device detects a signal from the previous data transmission device and sets the device as a master if the signal detection section of the device does not detect a signal from the previous data transmission device, and

when the device is set as the slave in the initial operation, sets the device as a slave if the signal detection section of the device detects a signal from the previous data transmission device and sets the device as a master if the signal detection section of the device does not detect a signal from the previous data transmission device.

4. The data transmission system according to claim 2, wherein,

the control section includes:

first shifting means for, when the device is set as the master in the initial operation, causing the lock signal sending means to send the lock signal and, in response to the signal detection section not detecting a signal from the previous data transmission device within a predetermined time period, setting the device as the master and performing shift to a first diag mode;

second shifting means for, when the device is set as the slave in the initial operation, setting the device as the master and performing the shift to the first diag mode in response to the signal detection section not detecting a signal from the

previous data transmission device within a predetermined time period;

third shifting means for, when the device is set as the slave in the initial operation, setting the device as the slave and performing the shift to the first diag mode in response to the signal detection section detecting a signal from the previous data transmission device within a predetermined time period;

fourth shifting means for, when the device is set as the master in the first diag mode, causing the lock signal sending means to send the lock signal and, in response to the signal detection section detecting a signal from the previous data transmission device during the first diag mode, setting the device as the slave and performing shift to a second diag mode;

fifth shifting means for, when the device is set as the master in the first diag mode, causing the lock signal sending means to send the lock signal and, in response to the signal detection section not detecting a signal from the previous data transmission device, setting the device as the master and performing the shift to the second diag mode; and

sixth shifting means for, when the device is set as the slave in the first diag mode, setting the device as the slave and performing the shift to the second diag mode, and

in the second diag mode,

the lock signal sending means

when the device is set as the master, sends to

the subsequent data transmission device the lock signal synchronizing with the held reference clock, and

when the device is set as the slave, receives the lock signal sent by the previous data transmission device and establishes clock synchronization and, after establishing the clock synchronization, sends the lock signal further to the subsequent data transmission device, and

the start signal sending means

when the device is set as the master, receives the start signal sending commencement signal from the start signal commencement timing generation means and thereafter sends the start signal to the subsequent data transmission device, and

when the device is set as the slave, sends the start signal to the subsequent data transmission device in response to reception of the start signal sent from the previous data transmission device.

5. The data transmission system according to claim 4, wherein,

the control section further includes:

seventh shifting means for, when the device is set as the master in the initial operation, causing the lock signal sending means to send the lock signal and, in response to the signal detection section detecting a signal from the previous data transmission device within a predetermined time period, setting

the device as the master and performing shift to a third diag mode; and

eighth shifting means for, when the device is set as the master in the third diag mode, causing the lock signal sending means to send the lock signal, setting the device as the master, and performing the shift to the second diag mode.

6. The data transmission system according to claim 5, wherein the signal detection section performs signal detection based on a presence or absence of the lock signal received from the previous data transmission device.

7. The data transmission system according to claim 5, wherein the signal detection section performs signal detection based on a presence or absence of establishment of the clock synchronization in the device.

8. The data transmission system according to claim 5, wherein the signal detection section performs signal detection based on a presence or absence of the start signal received from the previous data transmission device.

9. The data transmission system according to claim 2, wherein the communications protocol used by the processing section is defined by MOST (Media Oriented Systems Transport).

10. The data transmission system according to claim 5, wherein the processing section includes count means for counting a number of positional stages in relation to the data transmission device which is set as the master.

11. A data transmission method, in which a plurality of nodes are connected via a transmission line so as to form a ring structure, for performing unidirectional electrical communication after each of the nodes establishes clock synchronization using a predetermined communications protocol, the method comprising:

a step for setting one of the plurality of nodes as a master, which holds a reference clock, and setting another node as a slave;

a first lock signal sending step for, when the node is set as the master, sending to a subsequent node a lock signal synchronizing with the reference clock;

a clock synchronization step for establishing the clock synchronization using the lock signal sent from a previous node;

a second lock signal sending step for the node which is set as the slave establishing the clock synchronization and thereafter sending the lock signal to the subsequent node; and

a start signal sending step for sending, from the node, a start signal that indicates a data communication start timing,

the setting step, the first lock signal sending step,

the clock synchronization step, the second lock signal sending step, and the start signal sending step being performed in an initial operation, wherein,

the node which is set as the master performs the start signal sending step after a predetermined time period elapses after the first lock signal sending step is performed, and

the node which is set as the slave performs the start signal sending step in response to reception of the start signal from the previous node,

whereby each of the nodes performs initialization.

12. The data transmission method according to claim 11, further comprising a resetting step for resetting the node as the master or slave based on a presence or absence of a signal received from the previous node,

whereby, when there is a portion where the electrical communication is impossible, a node located most upstream in the electrical communication from the portion is finally set as the master, and clock synchronization with another node is established.

13. The data transmission method according to claim 12, wherein,

the resetting step causes the first lock signal sending step to be performed in the initial operation, and

the resetting step includes:

a step for, after it is recognized that the node which has been set as the master in the initial operation has not detected a signal from the previous node within a predetermined time period, setting as a slave a node which has detected a signal from the previous node, and setting as a master a node which has not detected a signal from the previous node; and

a step, performed by the node which has been set as the slave in the initial operation, for setting as a slave a node which has detected a signal from the previous node, and setting as a master a node which has not detected a signal from the previous node.

14. The data transmission method according to claim 12, wherein,

the resetting step includes:

a first shifting step performed after the first lock signal sending step is performed, for, in response to the node which has been set as the master not detecting a signal from the previous node within a predetermined time period, setting the node as the master and performing shift to a first diag mode;

a second shifting step for setting, of nodes which have been set as slaves, a node which has not detected a signal from the previous node within a predetermined time period as the master and performing the shift to the first diag mode;

a third shifting step for setting, of the nodes which

have been set as slaves, a node which has detected a signal from the previous node within the predetermined time period as the slave and performing the shift to the first diag mode;

a step, performed by the node which has been set as the master, for sending the lock signal to the subsequent node;

a fourth shifting step for setting, of nodes which have been set as the master, a node which has detected a signal from the previous node as the slave and performing shift to a second diag mode;

a fifth shifting step for setting, of the nodes which have been set as the master, a node which has not detected a signal from the previous node as the master and performing the shift to the second diag mode; and

a sixth shifting step for setting the node which has been set as the slave as the slave and performing the shift to the second diag mode,

the first shifting step, the second shifting step, and the third shifting step being performed in the initial operation, and

the step of sending the lock signal, the fourth shifting step, the fifth shifting step, and the sixth shifting step being performed in the first diag mode, and

in the second diag mode,

the first lock signal sending step, the clock synchronization step, and the second lock signal sending step are

performed,

the node which has been set as the master performs the start signal sending step after a predetermined time period elapses after the first lock signal sending step is performed, and

the node which has been set as the slave performs the start signal sending step in response to reception of the start signal from the previous node.

15. The data transmission method according to claim 14, wherein

the resetting step further includes:

a seventh shifting step, performed in the initial operation after the first lock signal sending step is performed, for, in response to the node which has been set as the master detecting a signal from the previous node within a predetermined time period, setting the node as the master and performing shift to a third diag mode; and

an eighth shifting step, performed in the third diag mode by the node which has been set as the master, for sending the lock signal to the subsequent node, setting the node as the master, and performing the shift to the second diag mode.

16. The data transmission method according to claim 15, wherein the resetting step resets a node as the master or slave

based on a presence or absence of detection of the lock signal received from the previous node.

17. The data transmission method according to claim 15, wherein the resetting step resets a node as the master or slave based on a presence or absence of establishment of the clock synchronization in the node.

18. The data transmission method according to claim 15, wherein the resetting step resets a node as the master or slave based on a presence or absence of detection of the start signal received from the previous node.

19. The data transmission method according to claim 12, wherein the communications protocol used by the nodes is defined by MOST (Media Oriented Systems Transport).

20. The data transmission method according to claim 15, further comprising a step for counting a number of positional stages in relation to the node which is set as the master, with respect to each of the nodes.

21. A data transmission device connected to a ring-shaped data transmission system for establishing clock synchronization with another device and performing unidirectional electrical

communication via a transmission line, the data transmission device comprising:

a processing section for processing data received and to be transmitted based on a predetermined communications protocol;

a transmission/reception section for outputting data received from a previous device to the processing section and transmitting a processing result from the processing section to a subsequent device;

a control section for setting the device as a master, which sends a signal synchronizing with a held reference clock to the subsequent device, or as a slave, which establishes clock synchronization using a signal received from the previous device and sends a signal to the subsequent device;

lock signal sending means for sending a lock signal in an initial operation;

clock synchronization means for receiving the lock signal sent by the previous device and establishing the clock synchronization;

start signal sending means for sending a start signal that indicates a data communication start timing;

start signal commencement timing generation means for, when the device is set as the master, outputting to the start signal sending means a start signal sending commencement signal indicating a timing at which to send the start signal, after a predetermined time period elapses after the lock signal sending means sends the

lock signal; and

a signal detection section for detecting whether a signal has been received from the previous device, wherein,

the lock signal sending means

when the device is set as the master, sends to the subsequent device the lock signal synchronizing with the held reference clock, and

when the device is set as the slave, receives the lock signal sent by the previous device to establish clock synchronization, and, after establishing the clock synchronization, sends the lock signal further to the subsequent device, and

the start signal sending means

when the device is set as the master, receives the start signal sending commencement signal from the start signal commencement timing generation means and thereafter sends the start signal to the subsequent device, and

when the device is set as the slave, sends the start signal to the subsequent device in response to reception of the start signal sent from the previous device.

22. The data transmission device according to claim 21, wherein

the control section sets the device as a master or a slave based on a presence or absence of a signal detection in the signal

detection section,

whereby, if there is a portion where the electrical communication is impossible in the data transmission system, and the device is located most upstream in the electrical communication from the portion, the device is set as the master.

23. The data transmission device according to claim 22, wherein,

the control section

when the device is set as the master in the initial operation, causes the lock signal sending means to send the lock signal and, after recognizing that the signal detection section has not detected a signal from the previous device within a predetermined time period, sets the device as a slave if the signal detection section of the device detects a signal from the previous device and sets the device as a master if the signal detection section of the device does not detect a signal from the previous device, and

when the device is set as the slave in the initial operation, sets the device as a slave if the signal detection section of the device detects a signal from the previous device and sets the device as a master if the signal detection section of the device does not detect a signal from the previous device.

24. The data transmission device according to claim 22,

wherein,

the control section includes:

first shifting means for, when the device is set as the master in the initial operation, causing the lock signal sending means to send the lock signal and, in response to the signal detection section not detecting a signal from the previous device within a predetermined time period, setting the device as the master and performing shift to a first diag mode;

second shifting means for, when the device is set as the slave in the initial operation, setting the device as the master and performing the shift to the first diag mode in response to the signal detection section not detecting a signal from the previous device within a predetermined time period;

third shifting means for, when the device is set as the slave in the initial operation, setting the device as the slave and performing the shift to the first diag mode in response to the signal detection section detecting a signal from the previous device within a predetermined time period;

fourth shifting means for, when the device is set as the master in the first diag mode, causing the lock signal sending means to send the lock signal and, in response to the signal detection section detecting a signal from the previous device during the first diag mode, setting the device as the slave and performing shift to a second diag mode;

fifth shifting means for, when the device is set as

the master in the first diag mode, causing the lock signal sending means to send the lock signal and, in response to the signal detection section not detecting a signal from the previous device, setting the device as the master and performing the shift to the second diag mode; and

sixth shifting means for, when the device is set as the slave in the first diag mode, setting the device as the slave and performing the shift to the second diag mode, and

in the second diag mode,

the lock signal sending means

when the device is set as the master, sends to the subsequent device the lock signal synchronizing with the held reference clock, and

when the device is set as the slave, receives the lock signal sent by the previous device and establishes clock synchronization and, after establishing the clock synchronization, sends the lock signal further to the subsequent device, and

the start signal sending means

when the device is set as the master, receives the start signal sending commencement signal from the start signal commencement timing generation means and thereafter sends the start signal to the subsequent device, and

when the device is set as the slave, sends the start signal to the subsequent device in response to reception of the start signal sent from the previous device.

25. The data transmission device according to claim 24, wherein,

the control section further includes:

seventh shifting means for, when the device is set as the master in the initial operation, causing the lock signal sending means to send the lock signal and, in response to the signal detection section detecting a signal from the previous device within a predetermined time period, setting the device as the master and performing shift to a third diag mode; and

eighth shifting means for, when the device is set as the master in the third diag mode, causing the lock signal sending means to send the lock signal, setting the device as the master, and performing the shift to the second diag mode.

26. The data transmission device according to claim 25, wherein the signal detection section performs signal detection based on a presence or absence of the lock signal received from the previous device.

27. The data transmission device according to claim 25, wherein the signal detection section performs signal detection based on a presence or absence of establishment of the clock synchronization in the device.

28. The data transmission device according to claim 25, wherein the signal detection section performs signal detection based on a presence or absence of the start signal received from the previous device.

29. The data transmission device according to claim 22, wherein the communications protocol used by the processing section is defined by MOST (Media Oriented Systems Transport).